What's preventing Growers from implementing PA?

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Key messages

- Adoption of VR in WA is now at about 20% of growers, up from <5 a few years ago, with many growers actively researching the technology and planning to adopt
- Hardware compatibility remains the major constraint
- Develop a variable rate maps is slow due to the complexity of software and data analysis tools
- The requirements of farmers are not uniform and the industry must avoid a “one-size-fits-all” mentality
- The agriculture consulting industry has not yet developed a system which addresses the range of farmer’s needs and expectations.

Introduction

Over the last 10 years GRDC has made considerable investments into precision agriculture (PA) RD&E across Australia and specifically in WA. A large body of knowledge has been built up on PA tools and approaches, quantifying the costs and benefits, experiences of early adopters and the needs of advisors and consultants. This has come at a time when there is growing interest in variable rate (VR) technology driven by the on-going rise in input costs for grain production placing greater emphasis on efficiency of input use; an increasing awareness and appreciation of the agronomic and economic benefits of VR; the active evaluation and perception of potential value by many current non-adopters; many adopters using a stepwise approach to adoption; and the greater availability and affordability of equipment. By working with a number of early adopters of VR over the last 7 years, encompassing a wide range of PA systems, we have gained some insights to the needs of various groups of adopters, what frustrates or prevents them from implementing VR on their farms and which tools have been helpful in making adoption and implementation decisions..

Aims

The aims of this paper are to: (1) update the status of adoption of PA and VRT in WA, (2) document categories of adopters of PA and their needs, and (3) describe some of the tools we believe can assist the adoption process, particularly in agri-business. Although PA covers a range of technologies, in this paper we have restricted our analysis to the adoption of VR as it applies to fertiliser management, as this is the main current use in the Australian grains industry. While other crop inputs such as seed, lime and gypsum are varied in space across Australian grain farms, by far the largest use of VR is for fertiliser application.

Status of adoption of PA in WA

Past surveys have indicated a low rate of adoption of VR by Australian grain growers. In 2008-9 we quantified the extent of VR adoption through a national survey covering all grain growing regions (1130 farmer responses). Two smaller WA-based surveys (65 and 102 responses) collected more detailed information on the nature and reasoning behind the use of various forms of the technology. The national survey showed 20% of WA and Australian grain growers have adopted some form of VR fertiliser (in different WA regions, this figure varied from 16 to 22%) (Table 1). This agrees with GRDC practices surveys and is up significantly from <5% recorded six years ago. Adopters are more than likely to have larger farms with a higher cropping percent. The smaller surveys confirmed there is a widespread and rapidly growing use of GPS technologies on farms, particularly guidance. There is also a wide appreciation of spatial variation and the benefits of managing it, primarily through varying inputs (fertiliser, lime, pesticides, and seed). Significantly, the perceived lack of agronomic and economic benefits of VR is not being cited as a constraint to adoption. Many growers are collecting information about, and considering adoption of, VR. A significant proportion of growers are managing within-field variability with manually-operated systems rather than more sophisticated VR technology, and are adopting some form of VR fertiliser without first collecting yield maps (see Table 1), preferring to use soil tests, electro-magnetic induction or their own knowledge of soil and yield variation to define management zones for VR fertiliser management. About two-thirds of farmers are yield monitoring but only around 50% are converting their yield data to yield maps. Anecdotal evidence suggests that these

growers are paying attention to yield variation by observing the yield monitor in operation at harvest time, albeit without taking the next step to converting the data to a map

Commonly cited constraints to adoption were technical issues with equipment and software. These were compounded by the lack of service provision and the fact that use of VR equipment is often incompatible with existing farm operations.

Table 1: Percentage of survey respondents using within-field variable rate fertiliser application and yield mapping in Western Australia and Australia overall. Data collected in 2008-09.

Region (number of respondents)	Have at least one crop yield map (%)	Using variable rate fertiliser on identified field zones in at least one field (%)	Using variable rate fertiliser on identified field zones in at least one field AND have at least one crop yield map
WA Northern (61)	41	16	11
WA Central (81)	40	22	9
WA South west (66)	29	21	9
WA All (208)	37	20	10
Australia (1170)	25	20	8

What do adopters of PA need?

The two dominant barriers to adoption of PA relate to hardware and to software and data analysis.

Hardware issues

Hardware is easier to measure, it either works or it doesn't and generally once it works, it will continue to. However, it must be made to work and it can be difficult to find from a proficient consultant that can address all the issues. The system involves integration of GPS receivers with and without correction signals, data control devices (screens) and variable rate controllers (on air cart, spreaders or sprayer). The ability to integrate these components varies depending on the knowledge and support from the local dealer and the cross-manufacturer compatibility. The ISO11783 standard was promoted as a solution to the hardware problem but has not yet eventuated. There is a lack of industry trained specialists that have the skills to diagnose and solve hardware problems across multiple manufacturers. In addition to machine companies training staff on their own hardware, there is a need for companies to understand the way in which their equipment interacts with hardware from other manufacturers. Regions that have this local technical support have moved ahead in adoption (e.g. Esperance and South Australia with SPAA). With time the market will cull the companies unable to integrate with other systems. This is already happening with cooperative agreements with machine manufacturers and PA equipment suppliers.

Software and Data analysis issues

The current manufacture based PA software is limited to viewing variability (usually from yield maps) and creating prescription maps directly from those maps. The higher level analysis required to develop variable rate maps is present in more sophisticated programs but these software packages are more difficult to us and have compatibility issues.

There are service providers that see all PA adaptors as having the same needs whereas there are numerous groups requiring different levels and systems of support (see below). There is a need for the agriculture support industry to develop the knowledge and support systems to address these various groups. There is confusion among farmers on the benefits and uses of other data layers (crop reflectance (NDVI and others), EM, radiometrics). An understanding among farmers and consultants to the benefits, usefulness and limitations of these data layers is essential before they will be accepted and utilized in the development of variable rate plans.

Classification of adopters

There is a continuum of growers from those that are self sufficient in their VRA capability to those that will require yearly on-going support. The difficulty for agribusiness is to identify and service these differing needs whilst recognising that VRA cannot be transformed into a one-size-fits-all package.

It has been assumed that the pattern of adoption of PA would follow the traditional curve which classifies growers into innovators, early adopters, early and late majority and laggards. This pattern assumes that the needs of each group are similar and only differ as to when adoption occurs. While this is true for the uptake of guidance and spray sectioning, VRA differs, because the needs and assistance required to support adoption varies from group to group. In working with numerous (>40) grain growers on adoption of VR over the last 5 years we can discern at least five groupings of growers that have different needs in the adoption process:

1. Early adopter and self sufficient growers. Often these growers that have developed a VRA program with the assistance of research project support. They are usually computer savvy and educated, and have researched the practices that they want to adopt. They need little additional support, and are able to diagnose and correct problems related to hardware and software. This group has learned first-hand or from colleagues of the problems of both hardware and software of the need to be more conscious when making purchase decisions. Because they are near self sufficient there is little need for support from a PA consultant. Local support for hardware related issues is the greatest need especially if it is not available in their region.
2. People having investigated the economics of VRA but need the assistance to get them to the level of self sufficiency. (3rd largest group) This group is characterised by young farmers, well educated with newer machines that are VRA capable, who need assistance to create a system from mismatched hardware. They need unbiased recommendations for new hardware. They have the ability to develop a full VRA program for the farm if they receive training in the advanced use of their PA software and would participate in research projects to develop a VR program. With time they may use a PA consultant to do routine data analysis
3. Farmers preferring to have others do the analysis but not make the decisions. (largest group) These people either do not have the confidence in their ability or time to work with the industry software to develop a VRA program. They are likely to have multiple years of yield data but have not used the information to develop a VR program. They are willing to pay for a service, but want to be part of the decision making process. Yield maps are used to confirm or fine-tune their own knowledge of the paddock variability. They are typically large operators with newer machines and therefore machinery compatibility is less of an issue.
4. Observers looking to get involved (2nd largest group). This group is characterized by intending to adopt if and when they have the equipment necessary. Some are at risk of being sold a “quick fix” but others are willing to sit back and wait until local support develops. They are often smaller operators with hardware issues (lack of or inability to operate) and the lack of data layers to assist in developing a VR program. They need unbiased hardware support and training to develop the VRA program or knowledge of what to request if they employ a PA consultant.
5. Lapsed adopter. These are often early adopters that employed a PA consultant or were involved in research program. They dis-adopted often due to the loss of assistance and/or the consulting industry unable to meet their needs in a timely way. They are usually large operators with new equipment, and hence do not have the equipment compatibility issue. They require yearly support for the PA program and are willing to pay if a service exists that meets their needs. They are pragmatic and will fall back to using blanket rates when assistance is not available.

Tools for PA

The investment in precision agriculture R&D by GRDC has culminated in a number of tools to help the industry make decisions about PA investment, variable rate fertiliser applications, soil sampling protocols, remote sensing surveys and on-farm trial design.

In the early part of the decade, PA technology was comparatively expensive and some growers invested between $50 and $100K to equip existing harvesters and carts with variable rate controllers. Growers were particularly interested in the likely payoff from purchasing this technology. Of particular interest was the time required (in years) to recoup the investment in the technology. Surveys of early adopters found this varied from between 2 and 5 years and importantly, was largely influenced by the area the technology was applied to, and the payoff expected from the technology on a per hectare basis. Some farmers reported pay offs of up to $15/ ha, while others reported payoffs of around $7/ha. Since the investment calculator was constructed the technology has become noticeably cheaper and is often factory-fitted. Thus if growers are planning to upgrade, the investment outlay may not be that great. The PA investment calculator is still available upon request to M Robertson (Michael.Robertson@csiro.au).

A second calculator has been constructed to evaluate the economic value of using VRT on a paddock. This calculator is a paddock based, and determines the likely return a farmer would achieve if phosphorus and nitrogen were variablye applied to a field over and above the return they would

generate from the same paddock if P and N were applied uniformly across the paddock. This calculator has found that variation in background levels of soil nutrients can be a large driver of the economic return that can be derived from VRT. Similarly paddocks with a large amount of yield variation are likely to generate a large return from implementing VRT. In general, large, variable paddocks where yields between zones vary by more than 1 t/ha generate returns of around $15/ha. The calculator can accommodate different fertiliser and grain prices, as well as areas of zones. For more details see Lawes et al in this issue of crop updates. The calculator can be obtained at http://environmentagriculture.curtin.edu.au/staff/rmandel.cfm

Paddock surveys with EM38 and Gamma ray spectrometry are now common place. Multiple companies offer these services. These surveys can provide insight into the amount of variation in soil properties across a paddock and are particularly good at detected changes in soil texture. Importantly, these surveys can be compared to yield maps and instantly, farmers can now tell whether changes in soil type, as detected by the surveys influence crop yield. These surveys can be used to then inform soil sampling surveys across the field. This information can be vital, as low yielding areas may have an excess of nutrients. In addition, they survey can help farmers decide what factors may be constraining yield. If necessary, lime or gypsum may be applied to ameliorate the constraint, thereby raising the potential yield of a particular soil. These surveys can therefore be combined with the calculator to determine the value of PA across a field. Combining traditional soil surveys with modern survey tools means growers can perform better diagnosis of problems across a field by knowing where to sample and what to sample for. CSIRO are currently developing a new classification tool to objectively classify soils using these surveys for release to the industry in 2011.

Finally, on farm trialling has evolved with the advent of precision agriculture technologies. Farmers have always been interested in running trials to evaluate new products or new ideas. PA technology gives farmers and consultants to do this easily on their own farm. Although PA equipment be easily used to run trials, many have failed. CSIRO have developed trial protocols for farmers and consultants (Lawes) and these should be closely followed to minimise the amount of inconvenience placed on the farmer during sowing and harvest. It is important to realise that unless you generate about a 200kg/ha yield difference (~–10%) you will not be able to detect the effect of the treatment on yield. For that reason, PA trials are best suited to evaluating quite radical differences in treatment, like 20-30 kg/ha difference in N or 4-8kg/ha of P. See Lawes 2010 crop update paper for more details on running on farm trials.

Conclusion

The farming community strongly endorses the adoption of precision agriculture technology to manage variability within paddocks. Nevertheless they have become frustrated with the technology, the lack of support for that technology, and this has impeded uptake more than any other factor. This implies they are comfortable making the appropriate agronomic decisions given the data and will move forward when they get the systems up and running. Education at all levels in the industry is required to move PA adoption forward. Consultants and agronomists need to be up-skilled so they can help farmers. At a practical level farmers need to gain the confidence in how to deal with variability and work in partnership with PA specialists. Machinery companies require a greater understanding of their role in PA technologies and how PA is being used. Unless all levels are up-skilled, adoption of VRT will remain low and the industry will not benefit from the potential gains.

Key words

PA, variability, VRT, technology

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